Monitoring of defoliation in mixed-aged Eucalyptus plantations using Landsat 5-TM

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The amount of foliage is one of the primary physiological controls of plant functioning, which ultimately influences plant survival and growth. Repeated severe defoliation events have been linked to reduced growth rates and tree mortality in Eucalyptus forests throughout the world. Satellite remote sensing provides a cost-effective alternative to traditional ground-based assessment of forest health.

In this study the potential of spectral mixture analysis for defoliation monitoring is evaluated. A novel spectral unmixing technique, referred to as weighted Multiple Endmember Spectral Mixture Analysis (wMESMA), was developed and successfully applied to Landsat 5 TM data acquired over a Eucalyptus globulus (Labill.) plantation in southern Australia. This technique combines an iterative mixture analysis cycle allowing endmembers to vary on a per pixel basis (MESMA) and a weighting algorithm that prioritizes wavebands based on their robustness against endmember variability. Spectral mixture analysis provides an estimate of the physically interpretable canopy cover, which is not necessarily correlated with defoliation in mixed aged plantations due to natural variation in canopy cover as stands age.

Results show that considerable variability in the degree of defoliation exists as well as in stand age amongst sites. In this study significantly improvement of the link between spectral unmixing and defoliation is observed by the inclusion of an age correction algorithm for the multispectral (R^2 no age correction = 0.55 vs. R^2 age correction = 0.73).